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Date 7/31/00 Label No. EC628221900

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**DARBY & DARBY P.C.**
805 Third Avenue
New York, New York 10022
212-527-7700

File No: 7875/0H358

Date: July 31, 2000

Hon. Commissioner of
Patents and Trademarks
Washington, DC 20231

Sir:

Enclosed please find an application for United States patent as identified below:

Inventor/s (name ALL inventors): Paul-Wilhelm BRAUN

Title: **TIMING DEVICE**

including the items indicated:

1. Specification and 15 claims: 3 indep.; 12 dep.; _ multiple dep.

2. [X] Declaration and power of attorney (Unexecuted)

3. [X] Formal drawings, 3 sheets (Figs. 1a-4)
   [] Informal drawings, _ sheet (Fig. )

4. [] Assignment for recording to:

5. [] Verified Statement Claiming Small Entity Status

6. [] Check in the amount of $.00, ($ filing; $ recording)
   (See attached Fee Computation Sheet)

7. [] Preliminary Amendment.

8. [] Please amend the description by inserting the following paragraph after the line containing the title on page 1: "This patent application claims the priority of U.S. provisional patent application No. 60/_____, which is incorporated herein by reference."

Priority is claimed for this application, corresponding application/s having been filed as follows:

| | |
|---|---|
| Country: | GERMANY |
| Number: | 100 29 380.8 |
| Date: | 20 JUNE 2000 |

The priority documents [] are enclosed
[X] will follow.

Respectfully submitted,

Christa Hildebrand

Christa Hildebrand
Reg. No. 34,953
Attorney for Applicant(s)

(D&DForms/PTO-1)

File No.: 7875/0G925

PATENT FEE COMPUTATION SHEET

| | No. of Claims Presented | Extra Claims Previously Paid For | Number of Extra Claims | Rate | |
|---|---|---|---|---|---|
| Basic Fee | | | | | $ |
| Design Application | | | | | |
| Plant Application | | | | | |
| Total Claims | - 20 | - | = | x $18.00 | $ |
| Independent Claims | - 3 | - | = | x $78.00 | $ |
| Multiple Dependent Claims | | x- if so, add | | $260.00 | $ |
| Surcharge for late submission of filing fee and/or declaration ($130.00) | | | | | $ |
| SUBTOTAL | | | | | $ |
| [] Small Entity REDUCTION (Half of Subtotal) | | | | | $ |
| Fee for recordation of assignment ($40.00) | | | | | $ |
| Charge for filing non-English language application ($130.00) | | | | | $ |
| TOTAL | | | | | $ |

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D B Peck — Name (Print)

Signature

7875/0H358

# APPLICATION FOR

# UNITED STATES LETTERS PATENT

## TIMING DEVICE

Inventors:

BRAUN, Paul-Wilhelm

# TIMING DEVICE

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

The present invention relates to a timing device such as a timing disk or a timing ruler which consists of a carrier having a first group of code markings disposed in at least one code track, which group of code markings is scanned by at least one sensor unit for producing a digital signal.

### 2. Description of the Related Art

A timing disk or a timing ruler of the aforedescribed type is described, for example, in U.S. patent 5,508,088 (common assignee's PWB basic patent). According to an embodiment of the device described therein, three concentric code tracks are arranged on a timing disk, with each of the code tracks having different markings. Three sensor units are required for scanning the three tracks, with the sensor units arranged in a similar manner as those of Figs. 1a, 1b or 2a, 2b of the known device. Accordingly, to scan several tracks disposed on a timing disk, several sensor units are arranged side-by-side in the radial direction, which increases the overall size of the scanning unit. In addition, several sensing devices require more complex electrical circuits, so that the device can more easily malfunction due to mechanical shock. The increased parts count and the more complex software introduces additional sources for errors. This is a significant disadvantage for the further improvement of printers, scanners and copiers. In practice, the carrier also ages which tend to make the carrier material opaque, or becomes contaminated, which is a particular problem with open systems such as inkjet printers. Both these situations can introduce errors if the sensor interprets the impurities as code markings.

## SUMMARY OF THE INVENTION

It is an object of the present invention to improve the design of the timing device such as timing disks or timing rulers to make them more robust and less error-prone. It is another object to simultaneously capture several separate optical signals using one sensor unit through simple, material-specific and circuit-related measures. It is yet another object to provide continuous signal amplification, as used for example with potentiometer systems, and to economically produce a simple position measurement device, for example for a steering angle sensor.

These and other objects are solved with the invention by the characterizing features recited in the claims. It has been observed that two or more groups of code markings can be detected independently from one another using a single sensor unit, if the code markings of the groups have a different optical density. "Optical density" refers to a gradation in gray levels between approximately 100% (dark-gray) to approximately 0% (fully transparent, fully reflective). Absolute positioning preferably is not attained by using bars, but rather by taking advantage of the increasing or decreasing gray levels. The optical density changes in this case, so that the sensor produces signals having a high intensity and corresponding to a low optical density and produces signals having a low intensity and corresponding to a high optical density, or vice versa.

The different groups of code markings in a track can be scanned simultaneously using a two-channel or a multi--channel sensor unit. The groups of code markings may also overlap one another. It is sufficient if the sensor unit senses a noticeable change in the optical density, which causes a corresponding change in the voltage captured by the sensor unit. Voltage

differences of, for example, 100 $\mu$V have proven to be adequate; however, other voltage differences can be used depending to the sensitivity of the measurement devices.

Suitable sensor units consist of an LED or another light source and of photo transistors or other light sensitive scanning devices. For controlling start and/or end positions or for calibration purposes, these sensor units can detect signals with either a constant separation or an arbitrary separation over the entire segment ranges of the timing disk or the timing ruler.

Other objects and features of the present invention will become apparent from the following detailed description considered in conjunction with the accompanying drawings. It is to be understood, however, that the drawings are intended solely for purposes of illustration and not as a definition of the limits of the invention, for which reference should be made to the appended claims.

## BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, wherein like reference numerals delineate similar elements throughout the several views:

FIG. 1a and b show a segment of a timing disk with different groups of code markings;

FIG. 2 shows a scanning signal from a sensor unit during scanning of a first group of code markings;

FIG. 3 shows a scanning signal from a sensor unit during scanning of a second group of code markings; and

FIG. 4 shows a combination of the scanning signals of Fig. 2 and Fig. 3.

## DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

Fig. 1a and b depict the segment of a timing disk having dark-gray and light-gray code bars. The steps in the different gray levels have to be selected so that aging and/or contamination of the timing disk does not produce erroneous scanning signals. The scanning signals of the regions a-b, b-c from the segment of the timing disk illustrated and Fig. 1b are recorded in the voltage-frequency curves depicted in Figs. 2 and 3. As can be seen, a large signal voltage corresponding to a large amplitude (due to the black tint of the bars) is produced in the region a-b, whereas only a reduced signal voltage corresponding to a smaller amplitude (due to the lesser optical density of the code bars) is detected in the region b-c. Comparable arguments can be applied to reflecting timing disks.

The following description is intended to explain the principle of the positioning measurement in more detail with reference to a specific example. Positioning measurement devices should enable contact-less photoelectric scanning of an incremental scale, while maintaining a high measurement accuracy. The pitch of the code markings can be changed with proper circuit design, for example by using phase-multiplying circuits or potentiometer circuits. If the pitch consists of consecutive light and a dark fields of identical size, then a photo transistor scanning across the pitch will produce a sinusoidal voltage with a wavelength corresponding to the sum of the two lengths of a light field and a dark field. Alternatively, the existing pitch can be subdivided further, thereby producing a potentiometer circuit.

The signal intensity of the standard timing disk remains constant. With an analog sensor, for example a sensor of the type Hewlett-Packard (Agilent Technologies) - Q 9846+0007, additional pulses for calibration are produced without requiring additional code tracks. An analog signal derived therefrom can be used for advancing paper, for stitching lines and/or for absolute positioning in printers, scanners or copiers.

According to the invention, in addition to the existing signals from the first group of code markings, a second variable is introduced, for example a change of the gray level of the code markings. The gray level determines the light transparency or the optical density and thereby the amplitude of signal. It is also possible to identify each angular position as an absolute position and to identify intermediate steps in analogy to an optical potentiometer.

Arbitrary intermediate steps can be encoded by a suitable gradation of the gray levels. In this way, certain segments of a timing disk or a timing ruler can be defined that are associated with additional functions.

Advantageously, although not necessarily, the signals of the first group of code markings can have a constant period independent of the gray level. Control devices of this type, due to their different light transparency, can also be applied to timing disks or timing rulers having slit markers for photo interrupters or other devices that produce an analog signal.

Thus, while there have been shown and described and pointed out fundamental novel features of the invention as applied to a preferred embodiment thereof, it will be understood that various omissions and substitutions and changes in the form and details of the devices illustrated, and in their operation, may be made by those skilled in the art without departing from the spirit of the invention. For example, it is expressly intended that all combinations of those elements and/or method steps which perform substantially the same function in substantially the same way to achieve the same results are within the scope of the invention. Substitutions of elements from one described embodiment to another are also fully intended and contemplated. It is also to be understood that the drawings are not necessarily drawn to scale but that they are merely conceptual in nature. It is the intention, therefore, to be limited only as indicated by the scope of the claims appended hereto.

What is claimed is:

1. A timing device comprising a carrier having at least one code track of a group and, overlapping therewith, at least one code marking, which is scanned by a sensor unit to produce signals, wherein the at least one code track has a different optical density compared to the first group, and wherein the code markings within a code track overlap.

2. The timing device according to claim 1, wherein the first group and additional groups of code markings are scanned by the same sensor-emitter-unit.

3. The timing device according to claim 2, wherein the code markings of the first group overlap with those of the additional groups within the code track.

4. The timing device according to claim 3, wherein the sensor unit comprises a light source and a light sensitive sensing device

5. The timing device according to claim 4, wherein in the sensor unit a two-channel evaluation of the optical signals is performed.

6. The timing device according to one of the preceding claims, wherein the first group of code markings has a predetermined optical density and the additional groups of code markings have optical densities different from that of the first group, with the code markings having a detectable grading for generating control or position signals.

7. The timing device according to claim 6, wherein the groups of code markings have a predefined difference in their optical density.

8.The timing device according to claim7, wherein the optical density corresponds to different gray levels which can span a range between light-blocking and almost complete transparency.

9. The timing device according to claim 8, wherein the carrier of the timing device is made of a reflecting material and the code markings have a different degree of reflectivity.

10. The timing device according to claims 9, wherein the code markings of the first group have a mutually constant spacing from one another, whereas the code markings of a second and subsequent group are distributed over the code track with an arbitrary spacing and are forming segments on the timing disk or the timing ruler for controlling different functions.

11. The timing device according to claim 10, wherein the code markings of the second and subsequent group are used for controlling one of a start and an end position, for one of calibration purposes and for absolute positioning.

12. A positioning device, comprising a timing device with a carrier having a first group of code markings in at least one code track, with the code markings being scanned by at least one sensor unit for producing a signal, and comprising a signal processing device, the signal processing device converts the sensor signal into a control signal and is connected after the sensor unit.

13. The timing device according to claim 4 , wherein the light source is a LED.

14. The timing device according to claim 4 , wherein the light sensitive sensing device is at least one photo transistor.

15. The timing device according to claim 5, wherein in the sensor unit performs a multi--channel evaluation of the optical signals is performed.

## ABSTRACT

A timing device, such a s a timing disk or a timing ruler is provided with a carrier having at least one code track of a group and overlapping therewith and at least one code marking, which is scanned by a sensor unit to produce signals. The code track or tracks have a different optical density in comparison to the first group, and the code markings within a code track overlap. Also disclosed is a positioning device which includes a timing disk or a timing ruler with a carrier having a first group of code markings in at least one code track. Here the code markings are scanned by at least one sensor unit for producing a signal and the signal processing device for converting the sensor signal into a control signal is connected after the sensor unit.

Fig. 1a

Timing disks with a black bar (180°) and a gray bar (180°)

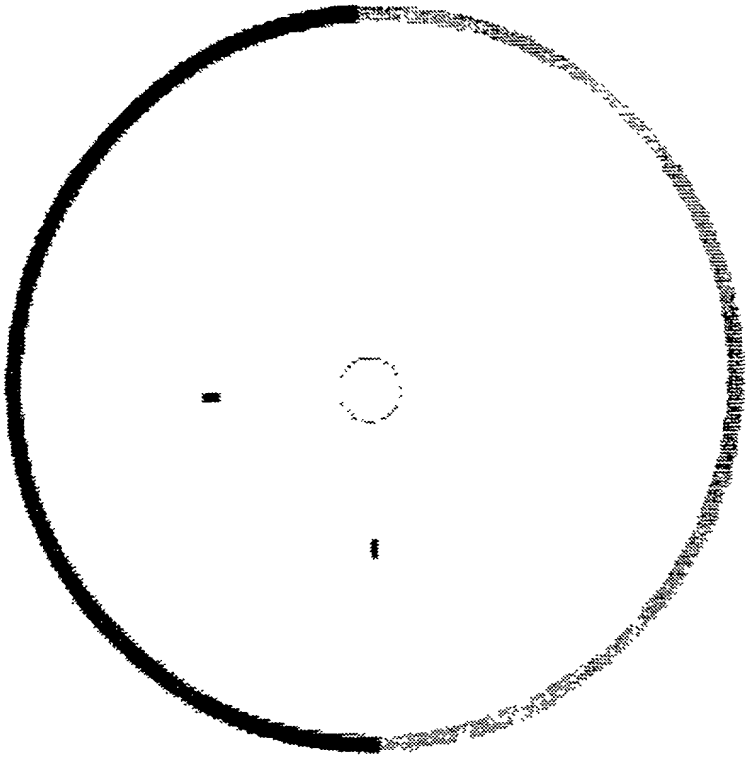


Fig. 1b

Timing disks with black and gray bars (detail)

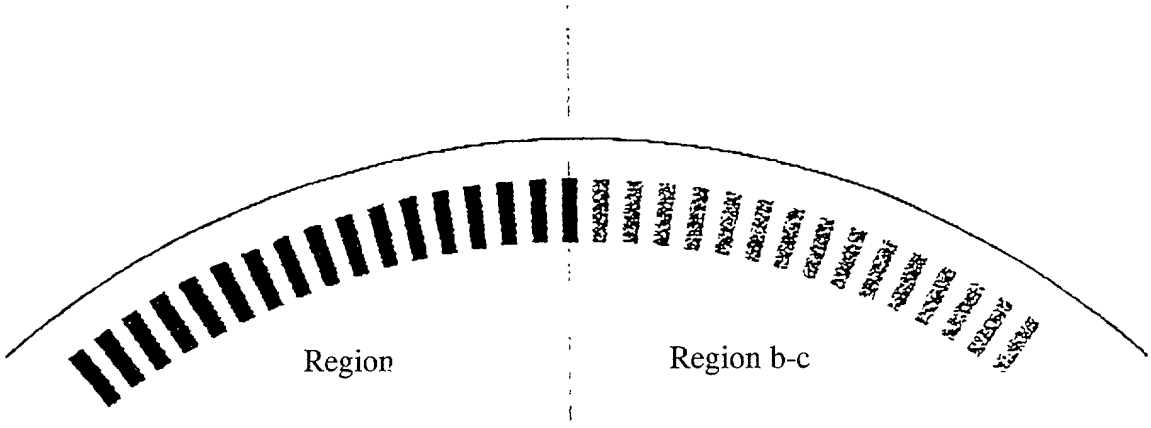


Fig. 2

Amplitude height for black bars (Region a-b)

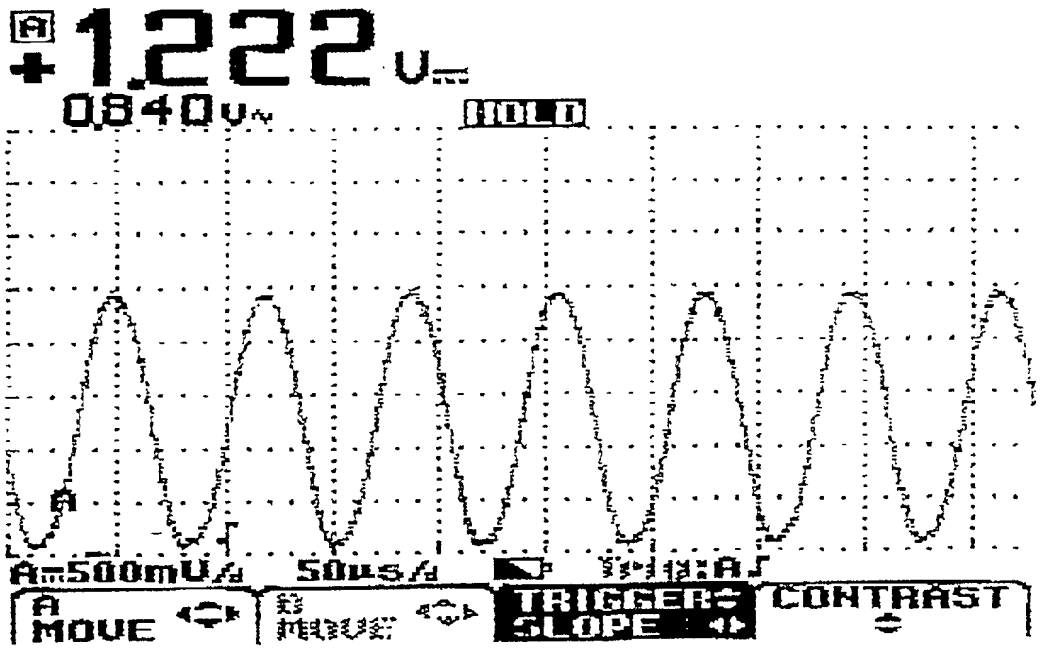



Fig. 3

Amplitude height for gray bars (Region b-c)

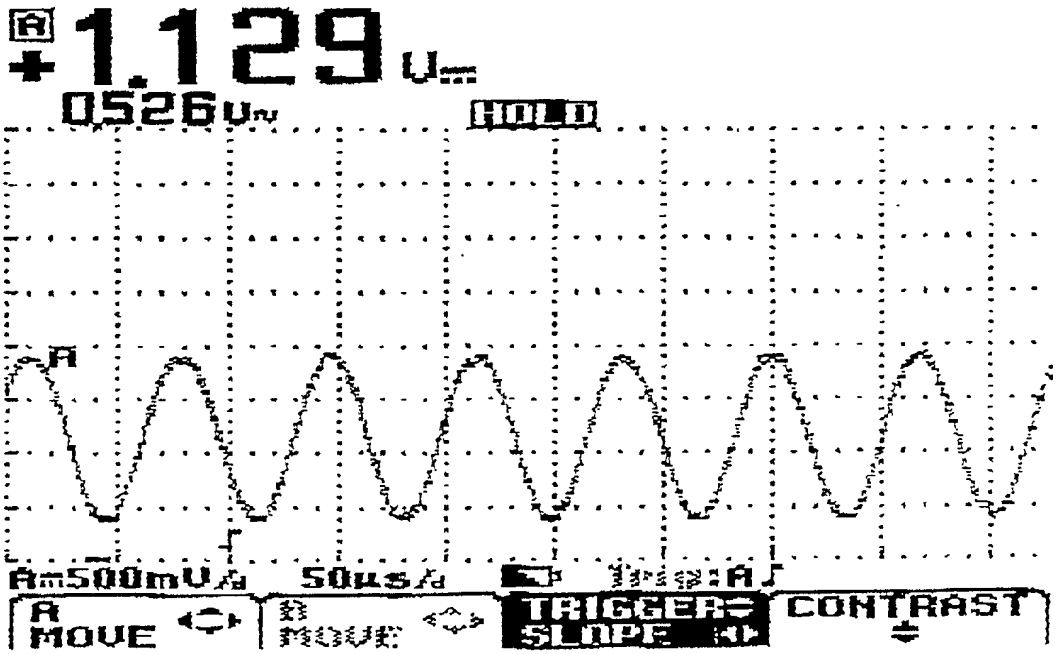
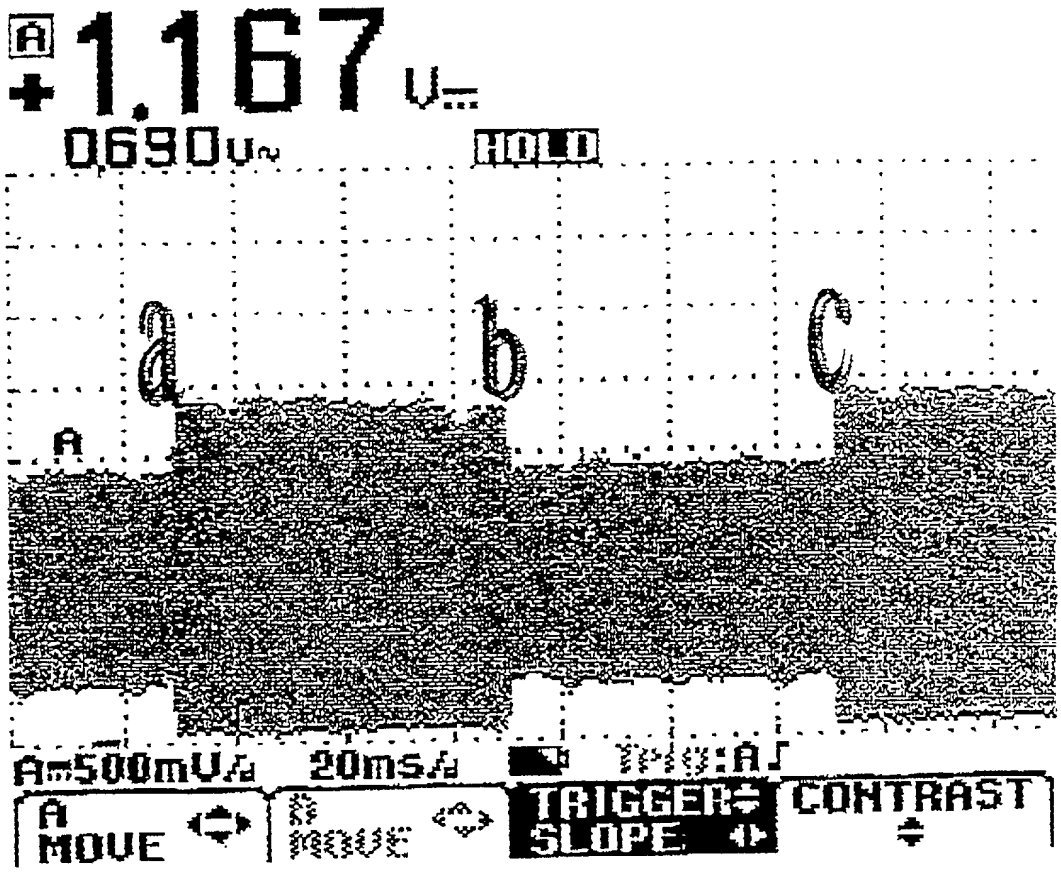


Fig. 4

Combination of the amplitude heights of Fig. 2 and Fig. 3.
The height of the amplitude is defined by the gray levels



7875/0H358

# Declaration and Power of Attorney For Patent Application
## *Erklärung Für Patentanmeldungen Mit Vollmacht*
## German Language Declaration

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides Statt:

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deren Beschreibung

(z utreffendes ankreuzen)

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☐ am _____ unter der

Anmeldungsseriennummer _____

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As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

**TIMING DEVICE**

the specification of which

(check one)

☒ is attached hereto.

☐ was filed on _____ as

Application Serial No. _____

and was amended on _____
(if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above; that I do not know and do not believe that the invention was ever known or used in the United States of America before my or our invention thereof; that I do not know and do not believe that the invention was ever patented or described in any printed publication in any country before my or our invention thereof or more than one year prior to this application; that I do not know and do not believe that the invention was in public use or on sale in the United States of America more than one year prior to this application; that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or asssigns more than twelve months prior to this application.

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I acknowledge the duty to disclose information which is material to patetnability as defined in Title 37, Code of Federal Regulations, §1.56.

Ich beanspruche hiermit ausländische Prioritätsvorteile gemäss Abschnitt 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 119 aller unten angegebenen Auslandsanmeldungen fur ein Patent oder eine Erfindersurkunde, und habe auch alle Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde nachstehend gekennzeichnet, die ein Anmeldedatum haben, das vor dem Anmeldedatum der Anmeldung liegt, für die Priorität beansprucht wird.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior foreign applications
Priorität beansprucht

| (Number) (Nummer) | (Country) (Land) | (Day/Month/Year Filed) (Tag/Monat/Jahr eingereicht) | Priority Claimed Yes Ja | No Nein |
|---|---|---|---|---|
| 100 29 380.8 | GERMANY | 20 JUNE 2000 | ☒ | ☐ |
| | | | ☐ | ☐ |
| | | | ☐ | ☐ |

Ich beanspruche hiermit gemäss Absatz 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 120, den Vorzug aller unten aufgeführten Anmeldungen und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in einer früheren amerikanischen Patentanmeldung laut dem ersten Paragraphen des Absatzes 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 112 offenhart ist, erkenne ich gemäss Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung und dem nationalen oder PCT internationalen Anmeldedatum dieser Anmeldung bekannt geworden sind.

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

| (Application Serial No.) (Anmeldeseriennummer) | (Filing Date) (Anmeldedatum) | (Status) (patentiert, anhängig, aufgegeben) | (Status) (patented, pending, abandoned) |
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Tradmark Office connected therewith. *(list name and registration number)*

Gordon D. Coplein #19,165, William F. Dudine, Jr. #20,569, Michael J. Sweedler #19,937, S. Peter Ludwig #25,351, Paul Fields #20,298, Harold E. Wurst #22,183, Joseph B. Lerch #26,936, Melvin C. Garner #26,272, Ethan Horwitz #27,646, Beverly B. Goodwin #28,417, Adda C. Gogoris #29,714, Martin E. Goldstein #20,869, Bert J. Lewen #19,407, Henry Sternberg #22,408, Robert A. Green #28,301, Peter C. Schechter #31,662, Robert Schaffer #31,194, David R. Francescani #25,159, Robert C. Sullivan, Jr. #30,499, Ira J. Levy #35,587, Joseph R. Robinson #33,448, Christa Hildebrand #34,953

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| Voller Name des einzigen oder ursprünglichen Erfinders:<br>**PAUL-WILHELM BRAUN** | Full name of sole or first inventor<br>**PAUL-WILHELM BRAUN** |
| Unterschrift des Erfinders Datum | Inventor's signature Date |
| Wohnsitz<br>**TROISDORF, GERMANY** | Residence<br>**TROISDORF, GERMANY** |
| Staatsangehörigkeit<br>**GERMAN** | Citizenship<br>**GERMAN** |
| Postanschrift<br>**LINDLAU STRAßE 23**<br>**53842 TROISDORF, GERMANY** | Post Office Address<br>**LINDLAU STRAßE 23**<br>**53842 TROISDORF, GERMANY** |
| | |

# GERMAN LANGUAGE DECLARATION

| | |
|---|---|
| Voller Name des zweiten Miterfinders (falls zutreffend) | Full name of second joint inventor, if any |
| Unterschrift des Erfinders Datum | Inventor's signature Date |
| Wohnsitz | Residence |
| Staatsangehörigkeit | Citizenship |
| Postanschrift | Post Office Address |
| | |
| Voller Name des dritten Miterfinders (falls zutreffend) | Full name of third joint inventor, if any |
| Unterschrift des Erfinders Datum | Inventor's signature Date |
| Wohnsitz | Residence |
| Staatsangehörigkeit | Citizenship |
| Postanschrift | Post Office Address |
| | |
| Voller Name des vierten Miterfinders (falls zutreffend) | Full name of fourth joint inventor, if any |
| Unterschrift des Erfinders Datum | Inventor's signature Date |
| Wohnsitz | Residence |
| Staatsangehörigkeit | Citizenship |
| Postanschrift | Post Office Address |

*(Bitte entsprechende Informationen und Unterschriften im Falle von dritten und weiteren Miterfindern angeben.)*

*(Supply similar information and signature for third and subsequent joint inventors.)*